

Big Sandy Formation Near Wikieup, Mohave County, Arizona

by RICHARD A. SHEPPARD and ARTHUR J. GUDE, 3D

CONTRIBUTIONS TO STRATIGRAPHY

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*Description of a newly named lacustrine
formation of Pliocene age in the valley of
the Big Sandy River of western Arizona*



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BIG SANDY FORMATION NEAR WIKIEUP, MOHAVE COUNTY, ARIZONA

By RICHARD A. SHEPPARD and ARTHUR J. GUDE, 3D

ABSTRACT

The Big Sandy Formation, a name here applied to a chiefly lacustrine deposit of Pliocene age, crops out in the valley of the Big Sandy River near Wikieup, Mohave County, Ariz. The formation has a maximum exposed thickness of about 245 feet and consists mainly of green and brown mudstone and thin interbedded tuffs, most of which are zeolitic. Coarser clastic rocks, including conglomerate, are in marginal parts of the formation and may locally be fluvial. The formation is unconformably overlain by Quaternary sedimentary deposits, and it unconformably overlies unnamed Tertiary sedimentary and volcanic rocks and Precambrian granitic rocks.

INTRODUCTION

Lacustrine deposits of late Tertiary age crop out along the Big Sandy River in Mohave County, Ariz., from about 5 miles north of Wikieup to about 7 miles south of that town. These lacustrine sediments were deposited in a basin elongated north to south between Hualapai Mountain on the west and Aquarius Cliffs on the east. Lee (1908) briefly mentioned these deposits in his geologic reconnaissance report of part of western Arizona. More recently, Morrison (1940) mapped sedimentary deposits in the valley of the Big Sandy River and included the lacustrine deposits in a widespread unit he called older fill.

We became interested in these lacustrine deposits in 1966 when an investigation was initiated to study the diagenetic alteration of interbedded silicic vitric tuffs. Ross (1928, 1941) had earlier described the formation of analcime, a zeolite, in tuffs of the lacustrine deposit near Wikieup, and he (1941, p. 627) also described a partial stratigraphic section, about 80 feet thick, of the lacustrine deposits.

LITHOLOGY, THICKNESS, AND BOUNDARIES OF THE BIG SANDY FORMATION

The Big Sandy Formation is herein named for the Big Sandy River, a southward-flowing tributary of the Bill Williams River. The formation extends over an area of about 30 square miles, and its distribution is shown in figure 1. The formation is well

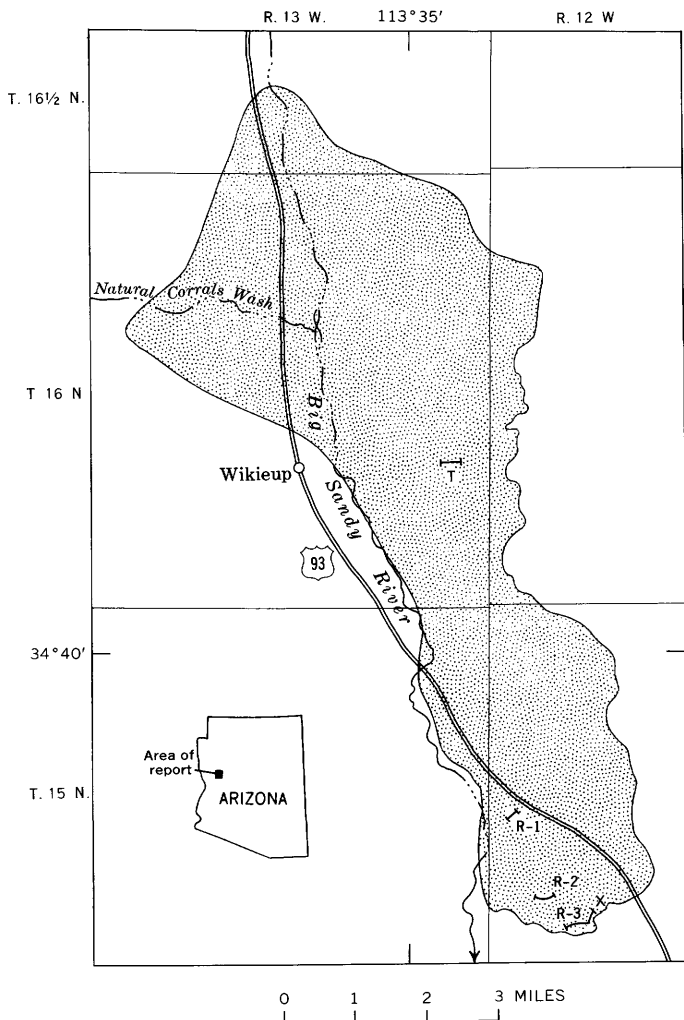


FIGURE 1.—Index map showing the distribution of the Big Sandy Formation (stippled) and locations of the type section (T) and reference sections (R-1, R-2, and R-3). X, fossil locality.

exposed in the steep bluffs east of the Big Sandy River, southward from Wikieup, and in the walls of many washes that head eastward from the river. Exposures of the formation lie at elevations of about 1,800–2,500 feet.

The greatest thickness of the Big Sandy Formation that was observed is about 245 feet, but the full thickness must be much greater. An unknown thickness of the formation was removed by erosion prior to deposition of the overlying Quaternary gravel. Nowhere are the basal beds exposed in the axial part of the basin.

The following section is the thickest continuous section measured, is typical of the formation, and is designated the type section:

Type section of the Big Sandy Formation

[Measured in amphitheater, about 2 miles east of Wikieup, along the section line between secs. 24 and 25, T. 16 N., R. 13 W., Wikieup quad., from about 1,200 ft east of section corner to about 2,400 ft east of section corner]

Quaternary gravel.

*Thickness
(feet)*

Unconformity.

Big Sandy Formation:

Mudstone, light-green; breaks with conchoidal fracture; contains lenses of green siltstone and fine- to medium-grained sandstone; abundant clusters of calcite crystals occur 6 ft above base of unit. Top of unit eroded -----	38.0
Mudstone, brownish-gray, poorly exposed; contains thin lenses of siltstone and fine-grained sandstone. Thin analcimic tuffs occur 5 and 9 ft above base of unit; lower tuff (0.3 ft thick) is greenish yellow; upper tuff (0.2 ft thick) is green in lower part and white in upper part -----	19.0
Tuff, yellowish-green, analcimic, laminated; lower part has small irregular cavities lined with calcite -----	1.1
Mudstone, grayish-brown and reddish-brown; small amount of greenish-brown mudstone in lower part; breaks with conchoidal fracture; contains thin lenses of siltstone and fine-grained sandstone; local calcareous concretions. The base of a discontinuous bed (0.0–0.5 ft thick) rich in altered pumice lapilli is 19 ft above base of unit. A gray to greenish-gray analcimic tuff (0.3–0.5 ft thick) occurs 28 ft above base of unit -----	64.0
Limestone, white; weathers pale gray; thin to medium bedded; contorted and fragmental internal structures; irregular cavities contain large yellowish-brown calcite crystals -----	3.0
Mudstone; mostly brownish gray to greenish gray but grades upward to green; contains thin lenses of siltstone and sandstone; local gray calcareous concretions; bedding contorted in upper 8 ft of unit. A yellowish-green analcimic tuff (0.0–0.3 ft thick) occurs 21 ft above base of unit -----	26.0
Mudstone, brown; breaks with conchoidal fracture; contains thin lenses of siltstone and fine-grained sandstone. A gray to green analcimic tuff (0.7 ft thick) occurs at top of unit; middle part of tuff rich in detrital grains; tuff probably equivalent to upper marker tuff -----	11.7

Big Sandy Formation—Continued

	<i>Thickness (feet)</i>
Mudstone, brown to reddish-brown; breaks with conchoidal fracture; local contorted bedding; common light-gray calcareous concretions. A light-green and white analcimic tuff (0.2 ft thick) occurs at top of unit -----	12.2
Sandstone, brown, fine-grained, thin-bedded, wavy-bedded, calcareous -----	1.0
Mudstone, brown to reddish-brown; breaks with conchoidal fracture; local contorted bedding; common light-gray calcareous concretions. A yellowish-green analcimic tuff (0.1–0.2 ft thick) occurs at top of unit -----	12.1
Lower marker tuff; green in lower part but white to light gray in upper part; multiple bedded; analcimic -----	1.5
Mudstone, brown; breaks with conchoidal fracture; contains numerous thin calcareous lenses. A conspicuous fine-grained sandstone (0.3 ft thick) occurs 3 ft from top of unit. Base of unit not exposed -----	7.0
Total Big Sandy Formation measured -----	196.6

The following short section of the Big Sandy Formation, designated reference section R-1 (fig. 1), was measured about 5 miles south of the type section, and it includes the lowest exposed part of the formation.

Reference section R-1 of the Big Sandy Formation

[Measured along bluffs east of the Big Sandy River in SW¼SW¼ sec. 18, T. 15 N., R. 12 W., Wikieup quad.]

Quaternary gravel.

Unconformity.

Big Sandy Formation:

	<i>Thickness (feet)</i>
Mudstone, greenish-gray; breaks with conchoidal fracture; poorly exposed. Top of unit eroded -----	4.0
Lower marker tuff; white to light gray except for yellowish-green middle; thin to medium bedded; multiple bedded; mostly resistant but locally friable and feldspathic; contains brownish-gray mudstone interbed in lower part; upper part locally silicified -----	3.0
Mudstone, yellowish-gray; breaks with conchoidal fracture; abundant crystal molds filled with calcite. At base of unit is a light-gray tuff (0.2 ft thick) that contains abundant detrital grains and consists of authigenic analcime and potassium feldspar -----	6.2
Mudstone, yellowish-brown and light-pink, massive; breaks with conchoidal fracture; local concentrations of crystal molds filled with calcite; calcareous in upper part -----	20.0
Sandstone, light-brown, tuffaceous, thin-bedded, crossbedded; locally calcareous; local concentrations of biotite; contains thin brown mudstone interbeds -----	2.0
Mudstone, pink and yellowish-brown, thin- to thick-bedded; breaks with conchoidal fracture -----	6.5

Big Sandy Formation—Continued

Thickness
(feet)

Mudstone, brown and yellowish-gray; small amount of light-red mudstone; breaks with conchoidal fracture. At top of unit is a yellowish-gray to pink tuff (0.5 ft thick) which consists chiefly of analcime and potassium feldspar and which grades upward into mudstone -----	7.0
Mudstone, yellowish-brown and olive-gray; breaks with conchoidal fracture; locally calcareous; local thin siltstone beds; base of unit not exposed. At top of unit is a pink to white tuff (0.2–0.3 ft thick) which has an uneven base and which grades upward into mudstone -----	9.2
Total Big Sandy Formation measured -----	57.9

The Big Sandy Formation consists chiefly of green and brown lacustrine mudstone or a calcareous silty or sandy variant (fig. 2). These rocks grade laterally into coarser clastic rocks, including conglomerate. The coarse-grained rocks are probably a marginal facies of the mudstone; however, some sandstone and conglomerate included in the formation may be of fluvial origin. The following reference sections, R-2 and R-3, were measured near the southern boundary of the formation (fig. 1) and are representative of the coarser clastic facies. Vertebrate fossils are common in the upper part of reference section R-3.

Tuffs are the most conspicuous and continuous strata in the formation. At least 13 tuffs were recognized, and they make up



FIGURE 2.—Typical outcrop of the Big Sandy Formation about 0.5 mile west of the type section. Arrows point to the lower marker tuff.

Reference section R-2 of the Big Sandy Formation

[Measured about 1 mile east of the Big Sandy River, along small washes from NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30 eastward to NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 15 N., R. 12 W., Greenwood Peak quad.]

Quaternary gravel.

Thickness
(feet)

Unconformity.

Big Sandy Formation:

Siltstone and sandstone, gray to greenish-gray, thin- to medium-bedded, zeolitic. Top of unit eroded -----	20.0
Upper marker tuff, yellow, multiple-bedded, zeolitic; breaks with a platy fracture; forms resistant ledge; locally silicified at top -----	2.2
Siltstone and mudstone, grayish-brown; small amount lenticular brown sandstone. Green analcimic tuff (0.2 ft thick) occurs at base of unit -----	5.7
Sandstone, siltstone, and mudstone, brown to gray, thin- to medium-bedded; thin lenticular conglomerates. Sandstone is fine to medium grained, poorly sorted, calcareous, and analcimic --	29.0
Lower marker tuff, green to light-gray, zeolitic; locally silicified in lowermost and uppermost parts; friable where green but breaks with a conchoidal fracture where light gray -----	.9
Sandstone, brownish-gray, thin- to medium-bedded, fine- to coarse-grained, locally calcareous, zeolitic; thin lenticular conglomerates -----	11.0
Sandstone and conglomerate, gray, thin- to medium-bedded, calcareous, zeolitic. Sandstone is mostly coarse grained and poorly sorted and consists chiefly of volcanic detritus, much of which is pumiceous. Conglomerate is lenticular and consists chiefly of rounded to subangular volcanic pebbles and cobbles --	4.0
Siltstone and sandstone, gray, thin-bedded; local small-scale cross-bedding. Base not exposed -----	5.0
Total Big Sandy Formation measured -----	77.8

Reference section R-3 of the Big Sandy Formation

[Measured along a wash that parallels Signal Road about 2,600 ft northwest of the road, from NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 29 to NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 29, T. 15 N., R. 12 W., Greenwood Peak quad.]

Quaternary gravel.

Thickness
(feet)

Unconformity.

Big Sandy Formation:

Siltstone and sandstone, green, locally calcareous, thin- to medium-bedded; sandstone is fine grained. Top of unit eroded. A yellow clinoptilolitic tuff (0.2 ft thick) occurs at base of unit -----	12.5
Sandstone and siltstone, green; abundant irregular calcareous concretions; poorly exposed -----	19.5
Siltstone and sandstone, green, thin- to medium-bedded. Vertebrate fossils are common, especially in siltstone in lower and upper several feet of unit -----	18.5
Sandstone and siltstone, green, thin- to medium-bedded; numerous gray silicified beds. Sandstone is fine to medium grained, poorly sorted, and zeolitic. Yellow to pale-gray tuffs occur 18 ft above base of unit and at top of unit; lower tuff (0.3 ft thick) consists	

Big Sandy Formation—Continued	Thickness (feet)
chiefly of mixed zeolites; upper tuff (0.4 ft thick) consists chiefly of erionite -----	32.3
Sandstone, siltstone, and conglomerate, brown, thin- to medium-bedded. Sandstone is fine to medium grained, poorly sorted, locally crossbedded, and zeolitic. Pebbles in conglomerate are chiefly volcanic. A white zeolitic tuff (0.5 ft thick) occurs 10 ft above base of unit -----	22.5
Upper marker tuff, white; breaks with platy fracture in upper and lower parts but with hackly fracture in middle; consists chiefly of clinoptilolite -----	2.7
Sandstone, brown, thin- to medium-bedded, fine- to coarse-grained, zeolitic. Yellow zeolitic tuff (0.2 ft thick) occurs at base of unit -----	5.2
Sandstone and conglomerate, brown, thin- to medium-bedded, zeolitic. Sandstone is fine to coarse grained, poorly sorted, and weakly indurated. Conglomerate is lenticular and consists of subangular volcanic pebbles. Base of unit not exposed -----	21.0
Total Big Sandy Formation measured -----	134.2

about 2–3 percent of the exposed formation. All the tuffs are altered and now consist of zeolites, potassium feldspar, clay minerals, and silica minerals of authigenic origin. The distribution and genesis of these minerals in the altered tuffs are the subjects of a report in preparation and are not discussed here. The tuffs are pastel shades of gray, yellow, or green, and they generally form ledges. The tuffs are 1–40 inches thick, but most are less than 6 inches thick. Most tuffs do not persist throughout the extent of the formation; however, two consistently thick and persistent tuffs in the lower exposed part of the formation have been given informal field names—lower marker tuff and upper marker tuff. The upper marker tuff occurs about 35 feet above the lower marker tuff (fig. 3).

Erosion and dissection of the nearly flat lying formation have proceeded to such a degree that most of the formation is characterized by badlands or dissected gravel-capped pediments. The Big Sandy River and its nearly mile wide, alluvium-filled channel transect the formation north of Wikieup, but south of Wikieup the western boundary of the formation lies along the river or in the channel (fig. 1). Much of the formation is concealed by either gravel-capped pediments or relatively recent alluvium of the Big Sandy River and its many tributaries.

The Big Sandy Formation unconformably overlies unnamed Tertiary sedimentary and volcanic rocks to the east and Tertiary volcanic rocks and Precambrian granitic rocks to the south. Small remnants of basalt crop out beneath the Big Sandy Formation in washes 2.5–3.0 miles east of Wikieup. These older rocks were probably islands in the lake during much of the deposition of the

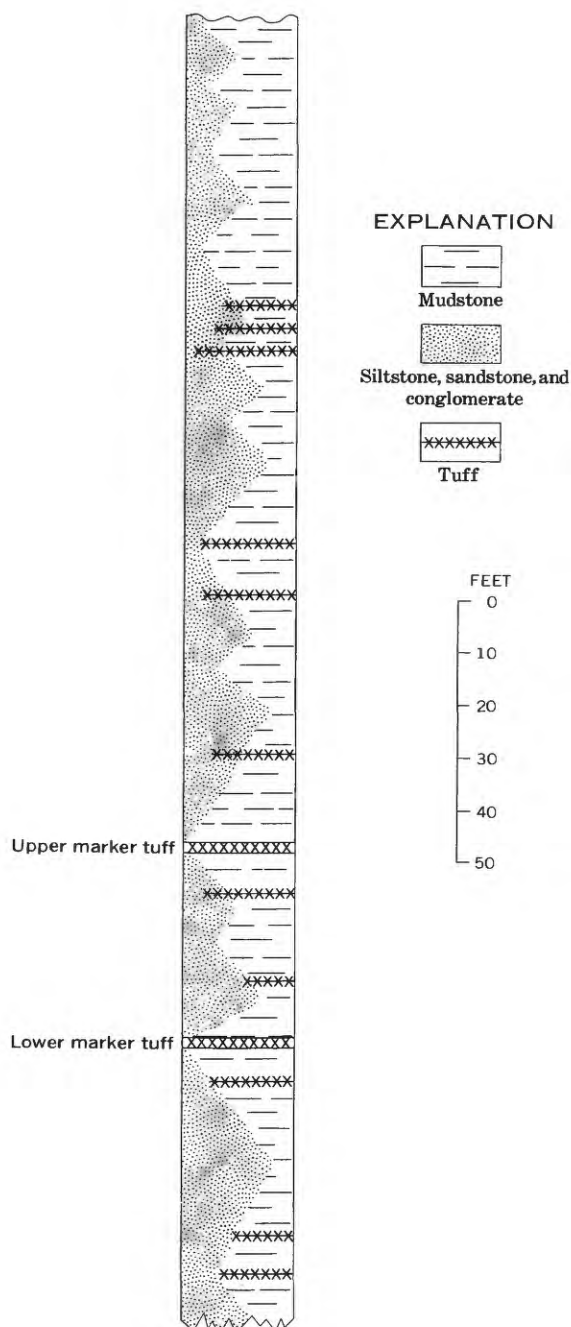


FIGURE 3.—Generalized columnar section of the Big Sandy Formation. Base of formation is not exposed; top is eroded.

Big Sandy Formation. The relationship of the formation to an unnamed thick, east-dipping fanglomerate deposit to the west is unknown, but the fanglomerate deposit is probably slightly older than the Big Sandy Formation. Compared with the Big Sandy Formation, the fanglomerate is more deeply dissected and it rests higher on the side of the valley of the Big Sandy River. The fanglomerate is intruded by a basaltic dike. Morrison (1940, p. 3) included the fanglomerate deposit in his older fill and concluded that the fanglomerate graded laterally into lacustrine rocks herein named the Big Sandy Formation. Our field evidence, however, does not confirm his conclusion.

Dips in the Big Sandy Formation are generally less than 2° , but steeper dips have been recorded. Local dips of as much as 10° were measured in Natural Corrals Wash, about 0.5 mile west of U.S. Highway 93. Normal faults of slight displacement cut the formation, particularly north of Wikieup. The greatest displacement measured was only 14 feet.

AGE OF THE BIG SANDY FORMATION

The Big Sandy Formation contains a rich vertebrate fauna, but little has been published on the fossils. Lance (1960) showed an early or middle Pliocene fossil locality in sedimentary deposits at Wikieup. However, data on neither the fossils nor the exact locality were given. Several paleontologists from the Frick Laboratory of the American Museum of Natural History have studied the vertebrate fossils from the Big Sandy Formation, but reports of those studies have not been published. The fossils were collected from two pits in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 29, T. 15 N., R. 12 W., Greenwood Peak quadrangle (fig. 1). The fossil-bearing strata are the same as those measured in the upper part of reference section R-3.

Ted Galusha of the Frick Laboratory (written commun., 1971) summarized his work and that of his colleagues as follows: "Based on studies of the Equidae, Camelidae, Antilocapridae, Canidae, Ursidae, Procyonidae, Mustelidae, and Felidae material from the Wikieup quarries, we are agreed that the fauna indicates a later Hemphillian age." Numerous teeth and bone fragments were collected in 1967 as float at the Frick Laboratory site. The fossils were identified as *?Pliohippus* cf. *P. leardi* Drescher by G. Edward Lewis of the U.S. Geological Survey, who stated (written commun., 1968) that this species of horse occurs in the upper part of the early Pliocene and in the late Pliocene. Thus, the Big Sandy Formation is definitely Pliocene and probably late Pliocene in age.

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